

Natural, organic and biodynamic wines: sustainability in the production chain

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Abstract— Concern for the environment is a recurrent aspect in any agricultural scenario under discussion and sustainability has taken on proportions of a wide debate reaching the most diverse markets, including the wine chain. From this reality began to emerge the labeling diversity of wines such as: organic, biodynamic and natural, demonstrating a growing interest of consumers in these products and producers in meeting this demand. The entire production chain, from grapes to wine, has been looking for more sustainable solutions so that wine exploration can last and impact the environment less and less. For a better understanding of this new panorama, of terms and products, the present work had as main objective to carry out a bibliographical review through consultation of scientific works published in areas related to the proposed theme, using key words to the theme that resulted in this article of review.

I. INTRODUCTION

Global and current concerns such as the loss of biodiversity and habitats, water scarcity, deterioration and desertification of soils leading to reduced productivity, show how it is necessary to change the paradigm, with regard to the way we use resources natural [1]. However, the need to apply sustainable practices along the value chain is still seen mostly as an economic cost and a threat to the profitability of companies, when, in fact, it is an opportunity [2].

A company distinguishes itself from its competition if it manages to be unique in some aspect of the production process or product that is valuable to buyers. In this way, the company differentiates itself from its competitors, as it allows it to have a low cost or to ask its buyers for a premium price. [3] considers pollution a form of inefficiency in the relationship between environmental sustainability and competitiveness. That is, when there is harmful waste or wasted energy, it is a sign that resources

have been used in an incomplete, inefficient and ineffective way. For the author, managers must begin to recognize environmental improvements as an economic and competitive opportunity, and not as an “annoying cost or unavoidable threat”. There are several studies that show that despite the environmental and social problems, economic performance is the most important factor for companies that intend to implement sustainability initiatives and practices. However, it is already clear that ecological practices have positive effects on efficiency, quality and customer satisfaction.

For a better understanding of sustainability practices, it is first necessary to know the concepts that permeate sustainable viticulture, as there is a confusion of understandings of what natural, organic and biodynamic wines are, and this review article aims to clarify these concepts.

II. METHOD

Bibliographical research of exploratory nature of articles published in national and international journals, published in the databases Scielo, Academic Google and Science direct, Scopus, Web of Science, EMBRAPA, Capes Periodicals, FAO, in the period between 2000 - 2021, without disregarding the classical authors.

The following keywords were used for the survey: agrobiodiversity, sustainability, sustainable viticulture, grape and wine production chain, wine classification, organic wines, natural wines, biodynamic wines, and sustainable territorialities.

Based on the works found, this review article was constructed.

III. RESULTS AND DISCUSSION

3.1 Natural, organic and biodynamic wines

The International Organization of Grape and Wine (OIV), in resolution CST 1/2004 of its Technical and Scientific Committee, defines the concept of sustainability in viticulture as: "A global approach to the production and processing systems of grapes, which involves the economic continuity of structures and territories, obtaining quality products, improving precision viticulture, assessing

environmental risks and product safety, safeguarding the health of consumers, enhancing heritage, historical and cultural aspects, scenic and ecological" [4].

The emergence of this concept, in an organization such as the OIV, followed the environmental concerns and the issue of sustainability that emerged worldwide after the Brundtland Commission report. In this context, the wine sector, like other intensive agro-industrial activities, contributes with an environmental impact that cannot be neglected. Despite the wine industry being one of the most innovative and competitive, environmental issues still lack the deserved attention [5]. For [6], sustainable viticulture is a much broader concept than organic and biodynamic viticulture.

Wine is a product obtained through the fermentation of grape juice, which can occur by chance, since the conditions for the process to occur are easy to obtain, considering that you only need to have some crushed grapes and a little bit of warmth and patience to get the wine [7].

3.2 Natural wines

To date, there is no consensus on the exact definition of what a natural wine is. Table 1 shows the different views on the definition of natural wine.

Table 1: Definitions on natural wine by various international natural wine associations.

Association	Definition of Natural Wine	Standards
<i>Raw Wine (United Kingdom, Germany, USA)</i>	Natural wine is cultivated organically or biodynamically, using permaculture or similar) and made (or rather transformed) without additives or processing aids the fermentation process that occurs naturally, without intervention. The result is a living wine - healthy and natural.	Vineyard: Organic / Biodynamic Grapes Winery: No additives (no sulfite added), no gluing, no filtration
<i>L'Association des Vins Naturels (France)</i>	Natural wine is: a wine whose grapes come from organic or biodynamic agriculture, a wine that is vinified and bottled without additives	Vineyard: Organic/Biodynamic Grapes Winery: No additives or sulphites
<i>S.A.I.N.S (France)</i>	Natural wine with no inputs and no added sulphites	It is not allowed to add sulfites or other additives
<i>Vini Veri (Italy)</i>	Lack of definition	Vineyard: Organic Grapes Winery: sulfur dioxide cannot exceed 80mg/l for dry wines and 100mg/l for sweet wines
<i>VinNatur (Italy)</i>	Lack of definition	Vineyard: No use of synthetic pesticides Winery: sulfur dioxide cannot exceed 50mg / l

APVN (Spain)	It is a wine made with natural grapes, without adding any input in the field or in the winery, just the grapes.	Vineyard: Fertilizer, herbicides, pesticides, systemic chemicals, fungicides or genetically modified organisms are not allowed. Winery: No added sulphite
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Author: [8]

In Brazil, although there is no official regulation for the use of the name “natural wine”, there is a certain consensus among producers about the practices allowed to obtain a wine in this style. For most producers, natural wine is basically grape must from organic vines fermented from indigenous yeasts present in the fruit itself and without any intervention. In this way, sulfur is almost always banned and many winemakers are opposed to the use of oak aging as well. Natural wine's main characteristic is the absence of any compound added to the drink, from preservatives to any oenological inputs widely used in the traditional wine industry.

Natural wines are often quite sensitive and unstable. It is noteworthy that there is still no regulation on the use of the term “natural wine” and producers can interpret it in different ways.

3.3 Organic wines

The definition of “organic wine” varies depending on the location, because the laws that regulate its production are different in each country. In Brazil, the law that regulates is Law No. 10,831, of December 23, 2003 and the registered decree of Law No. 6323, which regulates the issue of production and marketing of organic foods.

What is considered organic wine, today, is the drink that comes from an organic plantation of grapes, regardless of the wine-making process. Organic wines are made from grapes grown biologically without the use of synthetic fertilizers and without the application of pesticides on the plants. The management of the vineyard is based on the use of natural products and in biological balance, to prevent the appearance of insects, fungi, spontaneous plants and/or other threats to the vineyard.

One of the main concerns of organic farming is the soil, and growers avoid unnatural substances to regulate the land and vines. According to them, the final concern is the consumer, who should not ingest residual pesticides through wine.

This type of cultivation is controlled by certifying bodies and inspecting the entire process. In certain places, the rules are more or less strict. There are countries, for example, that do not allow any chemical additives in the

process at all. In others, however, the winegrower is allowed to use acidifiers and preservatives.

Although there are differences between countries about what is considered an “organic” product, public policies of mutual understanding can help to overcome this barrier. This is what Brazil and Chile did in April 2019, when they put into practice an agreement for the equivalence of organic products between the two countries. Signed in September 2018, the agreement establishes that Chile will recognize the certification made by Brazil to buy Brazilian organic products, and Brazil will accept certification from Chileans.

3.4 Biodynamic wines

A biodynamic wine can be understood as a combination of biological agricultural practices without the addition of synthetic chemicals, with biodynamic practices in order to influence the biological and metaphysical aspects of the vine and adapting the vines to the lunar phases, such as example the harvest on the night of the full moon, etc.

Biodynamic wines, in addition to being made from organically grown grapes, their producers follow the anthroposophical philosophy, proposed in 1924 by Rudolf Steiner. According to the principles of Steiner's philosophy, an agricultural farm should seek to be a fully self-sustaining environment, in harmony with the cosmos, with minimal interference from man, so that the land can recover its vital energy and produce fruits that express its characteristics. own of the place.

The rules for this type of agriculture were laid down in the book “The Spiritual Foundations of Biodynamic Methods”. In it, it is stated that the processes in both the vineyard and the winery are governed by the position of the planets and the phases of the moon. No pesticides and fertilizers are used, however, the producer can initially rely on biodynamic preparations, based on medicinal herbs and minerals, until the ecosystem recovers its balance and requires less and less human action. The same precepts are followed in wine making, with as little interference as possible in the winemaking, without using active dry yeasts and with minimal (or no) preservatives.

As well as organic agriculture, there are bodies to regulate and authenticate producers who venture into biodynamic agriculture. In Brazil, it is represented by the Institute Biodynamic Certification Association (IBD). To be biodynamic, the label must comply with the rules of the “Demeter Seal”, an American organization that regulates this style of wine.

3.5 Environmental, social and governance (ESG) in the wine production chain

ESG is an acronym in English that stands for environmental, social and governance, and corresponds to an organization's environmental, social and governance practices. The term was coined in 2004 in a Global Compact publication in partnership with the World Bank called Who Cares Wins. It arose from a provocation by UN Secretary General Kofi Annan to 50 CEOs of large financial institutions, about how to integrate social, environmental and governance factors in the capital market.

The understanding and applicability of ESG criteria by Brazilian companies is increasingly a reality. Acting in accordance with ESG standards increases the competitiveness of the business sector, whether in the domestic market or abroad. In today's world, in which companies are closely monitored by their various stakeholders, ESG is an indication of solidity, lower costs, better reputation and greater resilience amidst uncertainties and vulnerabilities, being an important indicator of sustainability in the production chain of wine.

For many producers, sustainability is seen only as an environmental issue, where a sustainable wine is synonymous with biological or biodynamic [9]. For [6], sustainable viticulture is a much broader concept than viticulture biological, biodynamic or in integrated production. An organic wine is made from grapes cultivated biologically without the use of synthetic fertilizers and without the application of pesticides on the plants. A biodynamic wine can be understood as the combination of biological agricultural practices without the addition of synthetic chemical products, with “dynamic” practices in order to influence the biological and metaphysical aspects of the vine and adapting the cultures to the lunar phases, such as the harvest on the night of the full moon, etc.

According to [10] a vineyard with integrated pest management is a long-term approach through a combination of biological and cultural inputs in order to minimize environmental, health and economic risks.

[11], in a study carried out in 7 different countries, concluded that sustainability is a very individual and personal concept. However [12] emphasize that

environmental aspects and concerns are the most studied in the concept of sustainability.

Environmental concerns in the vineyard are not only related to impacts on biodiversity, but also to workers. For [13] the use of pesticides can be effective and cheap, but it is also highly toxic for workers and wild animals.

[5] Emphasize that most environmental problems faced by wine organizations are intrinsically interrelated, suggesting that environmental sustainability at the industry and corporate level will only be achieved with a holistic approach.

For [14], the discussion of sustainability in the wine industry raises issues ranging from viticulture, followed by industrial operations and management (cellar) and distribution processes. For this author, analyzing the concept of sustainability of the International Organization of Grape and Wine (OIV), the social pillar has a broad approach emphasizing immaterial themes such as heritage, history and culture.

[11], argue that sustainability can be generically defined as an environmentally friendly production, socially equitable in the relationship between the company, workers and local communities, and at the same time being economically viable. For this author, the perception of the benefits of adopting a sustainable strategy translates into the manifestation of competitive advantages based on cost reduction and product differentiation.

A sustainable strategy can translate into increased productivity, not only in reducing the consumption of external inputs such as phytopharmaceuticals, water and energy, but also in process innovation due to a better application of existing production techniques, or implementation of new technologies such as energy renewables and more efficient equipment [15]. For these authors, the application of an improvement in existing technology can lead not only to a reduction in costs, but also to the development of a product for a new market segment, for example, when consumers are willing to pay a price -premium for an “environmentally friendly” wine. In this perspective, an environmentally sustainable wine can bring a competitive advantage if it is consumed in higher income markets, such as Europe and North America.

[16] report that there is no universally accepted definition of sustainability, nor consistent indicators that could assess individual organizations. According to the same authors, the most important economic indicators for producers are grape quality, economic yield and production costs. With regard to environmental indicators, producers first enumerate soil quality, water use and putting an end to biodiversity. In relation to the social

dimension, the main indicators are the retention of workers, training and a healthy work environment.

[17] argue that the challenges of sustainability can be better achieved if there is a balance between the economic, environmental and social dimensions, where companies should assess their performance based on their social and environmental impacts, in addition to their traditional objective of profit maximization. Producers who have implemented environmentally sustainable practices recognize the long-term relationships between the environmental, social and economic dimensions and believe that these practices are directly linked to improving the quality of the soil, grapes and wine or terroir [18].

[19], identified four reasons or stimuli that lead companies to adopt sustainable practices: a) strategic reasons aimed at increasing competitiveness, product differentiation, access to markets, positive image and reputation, and product quality; b) financial incentives such as cost reduction, greater efficiency and increased profits; c) internal reasons linked to management attitudes, employees, organizational culture, internal pressure on managers and social involvement activities; and d) external stimuli related to pressure from customers, investors, local communities, competitors and current legislation.

For [20], the analysis of the various motivations that lead economic agents in the wine sector to adopt sustainable practices is the first step to understand the relationship between companies and sustainability and to verify their behavior in response to certain stimuli. time that explain the different levels of sustainability in which a company or a country finds itself. The reasons may be ethical issues or strategic decisions based on the perception of a competitive advantage arising from sustainability, or even external stimuli imposed by the company's external institutional context.

3.2 Sustainability Programs

The sustainability program of Lodi and other regions of California has been adapted and adopted by CSWA with the aim of optimizing the quality of the grape, protecting and conserving the environment, maintaining the long-term viability of agricultural land and local communities, ensure the economic and social well-being of employed farmers, and support research and training, among others [16].

In 1995, the first sustainability program in New Zealand appeared, Sustainable Winegrowing New Zealand –SWNZ [11];[16];[20]. SWNZ certification started only with viticulture practices and, later, in 2002 certification was carried out jointly with the viticulture and winery operations. In this case, the use of a benchmarking system

aimed to continuously improve sustainability in both operations: vineyard and winery [11].

This system brought advantages to producers, as they could obtain a benchmarking not only regionally but also nationally in relation to the use of energy, water and agrochemicals and could verify where they were, taking advantage of the dissemination of research results [21].

In 1998, the South African government enacted the Integrated Production of Wine (IPW). In this case, it was a program with a marketing message, with a voluntary certification, a manual and guidelines of the practices to be implemented, providing information about the minimum requirements to reach the goals defined by the legislation of the Republic of South Africa [16]. The IPW, without being mandatory, turned out to be the starting point to assist producers in environmental aspects, given their lack of knowledge and resources to determine the environmental impacts of their activities [22]. The IPW was a tool to help and support producers to get started in sustainability practices.

During the first decade of this century, Australia received a visit from Dr. Cliff Ohmart, at the invitation of the McLaren Vale Grape Wine & Tourism Association, who influenced the creation of a regional sustainable viticulture program including a plan for certification, which developed a series of initiatives aimed at improving winemaking practices, grape quality and financial viability. To this end, they carried out various initiatives such as seminars and workshops and the preparation of an information bulletin for winemakers with data from meteorological stations and pest alerts in the region [16].

In 2009, “Vinos de Chile”, a non-profit organization that represents 95% of bottled wines exported from Chile, launched a strategic plan for Chilean wines until 2020. This strategic plan marked sustainability as one of the main keys and was part of partnership between representatives of the wine industry and the University of Talca that created the National Code of Sustainability (CNS), encompassing a series of initiatives with the objective of establishing the sustainability of Chilean wines [16]. To this end, the CNS encompasses three areas: Viñedo (green area) with a focus on natural resources, pests and diseases, agrochemicals and occupational safety; Bodega (red area) which includes chapters such as energy, water management, contamination and waste prevention; Social (orange area), which includes relations with workers, communities and customers.

In 2015 a pioneering sustainability plan emerged in Portugal. The Alentejo Wine Sustainability Program (PSVA) emerged from a partnership between the University of Évora and CVRA and with financial support

from the European Union through the Alentejo Regional Operational Programme. As a voluntary membership program, its main objective is to provide recommendations to Alentejo producers with a view to improving their sustainability and competitiveness. To this end, a plan was developed based on three sectors: Viticulture, which includes several chapters related to the production of grapes; Winery, which includes chapters related to wine production; and Viticultura & Winery, which includes various implications of winemaking operations, such as wine quality, ecosystem management, human resources, surrounding communities, socioeconomic and regional development [23]. This document contains 177 evaluation criteria distributed across these three sectors indicated above. This program is intended to: support producers in improving their environmental, economic and social performance, promoting the sustainability of the region's wines; promote the efficient use of resources and reduction of operating costs in the wine industry; support the production of wines with recognized sustainable performance, through knowledge obtained in Research and Development projects and identify the performance of producers, comparing results and defining areas for improvement [24]. As a result of this initiative, PSVA managed to successfully integrate 168 members (wine and grape producers (or both products) and have associated the equivalent of 26% of the Alentejo vineyard area.

In relation to the various sustainability programs we cover, there are national programs such as New Zealand, South Africa and Chile, state programs such as California and regional programs such as McLaren Vale in Australia or Alentejo in Portugal. In Europe there are also other sustainability programs, in countries like France, Italy and Switzerland, although with fragmented initiatives, not having a regional format [14].

With regard to New World wines, most sustainability programs are linked to Public Institutes and Universities have a very important role in the transfer and sharing of knowledge. [20] emphasizes that a close relationship with the University can bring benefits to the wine industry, as the research results can help producers adopt sustainable practices and can provide answers to some management questions. The social responsibility of research can help guide sustainability by disseminating results that motivate economic agents to adopt a sustainable behavior and create an awareness of sustainability in industry and consumers.

Although the relationship between the University and economic agents has had good results in the sustainability program in California, [5] found that organizations in the wine sector often encounter difficulties in transferring results from scientific research to practice. These authors advocate further research with a primary interest in

commercial reality and perceptions of environmental concerns. The transfer of knowledge, the realization of synergies with the territory and a greater commitment of companies to research and development (ID) activities constitute challenges with a view to economic development [25]. Undoubtedly, "the widespread adoption of sustainable winemaking practices depends not only on rigorous science, but also on their effective delivery to producers" [13].

And it is in pursuit of this sustainable growth that the production chain of grapes and wine must be guided from now on, giving economic continuity to structures and territories, obtaining quality products, improving precision viticulture, assessing risks environmental and product safety, safeguarding the health of consumers, enhancing the heritage, historical, cultural, landscape and ecological aspects of all producing regions.

IV. CONCLUSION

It is possible to affirm that natural, organic and biodynamic wines are products that best represent the characteristics of the place where they were made, capturing the essence of the soil and climate, that is, these wines fully express the "Terroir" of each region that produces them.

There is no consensus on the definitions of natural, organic and biodynamic wines, these concepts are specific to each country/association.

From the literature review it was found that the main grape and wine producing countries around the world have sustainability programs in place, which demonstrates the concern to keep the exploration of this activity in an increasingly clean and lasting way.

New Zealand was the first country to implement a sustainability program in 1995 for grapes and in 2002 for wine, serving as an example for other countries that used this practice to build their own programs.

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